COMPARISON OF STATISTICAL DISTRIBUTIONS TO ESTIMATE HYPOGLYCEMIA AND HYPERGLYCEMIA METRICS

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Introduction

With the availability of continuous glucose (CGM) data, statistical distributions have been used to estimate hypoglycemia and hyperglycemia metrics when data is sparse and to reduce the effect of outliers. Two distributions have been used: the lognormal distribution and the gamma distribution. The latter is used in the FreeStyle Libre Glucose Pattern Insights Report for determination of zones of low, moderate and high hypoglycemia[1].

Objective

Determine if one distribution (Lognormal or Gamma) is better than the other for estimating hypoglycemia and hyperglycemia metrics.

Methods

The two distributions were fit to CGM data from the baseline period of a study[2] (n=87, average 11.5 days data per subject, T1DM=42, T2DM=45) on a per subject basis. Metrics for hypoglycemia and hyperglycemia (Daily Average Minutes Below 70 mg/dL or MB70, and Minutes Above 240 mg/dL or MA240) are estimated for each subject from the distribution fitted to the data for that subject. These metrics were also measured directly from the data for each subject. Agreement between the estimates and measurements of metrics was evaluated by linear regression and Bland-Altman analyses.

Results

Both distributions fit CGM glucose data reasonably well. It was observed that the lower tail of the Gamma distribution fit the probability of low glucose values slightly better compared to the lognormal distribution, as seen in Figure 1.

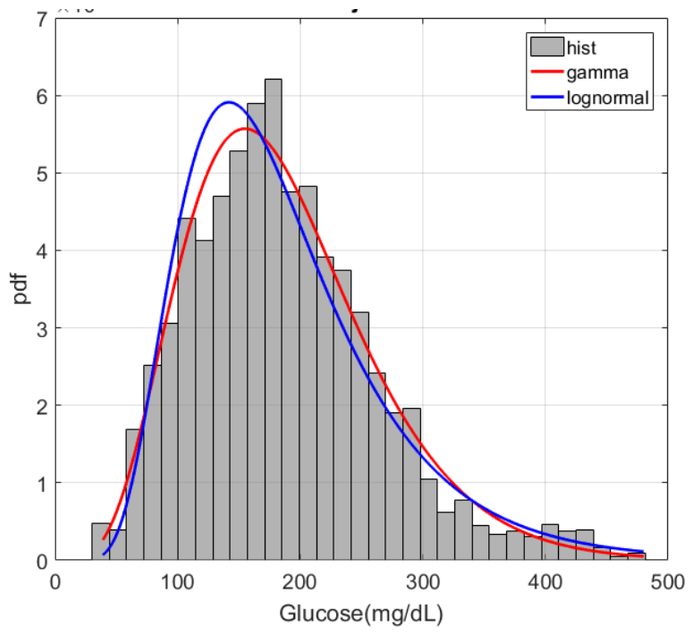

Figure 1. Example histogram plot for one subject showing fit of the distributions to glucose data for 14 days of sensor wear.

It was observed that estimates showed strong correlation with the measured MB70 and MA240 values as shown in Figure 2 for both distributions.

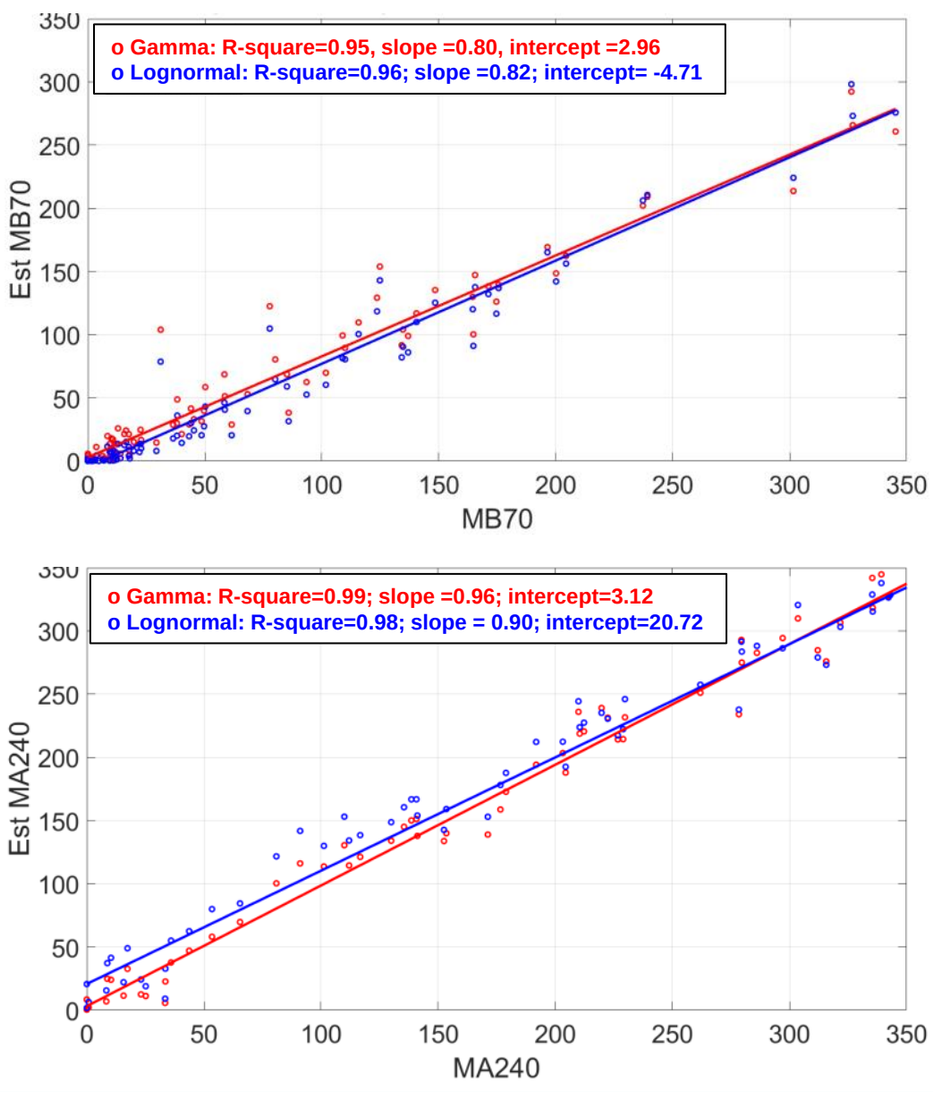

Figure 2. Linear regression plots showing degree of correlation between estimates and measured values of hypoglycemia (MB70) and hyperglycemia (MA240) metrics. Both axes are truncated to 350 min.

Results

The bias against measured values was analyzed using a Bland-Altman plot (Figure 3). The lognormal distribution slightly underestimated MB70 compared to the gamma. The gamma distribution slightly underestimated MA240 compared to the lognormal.

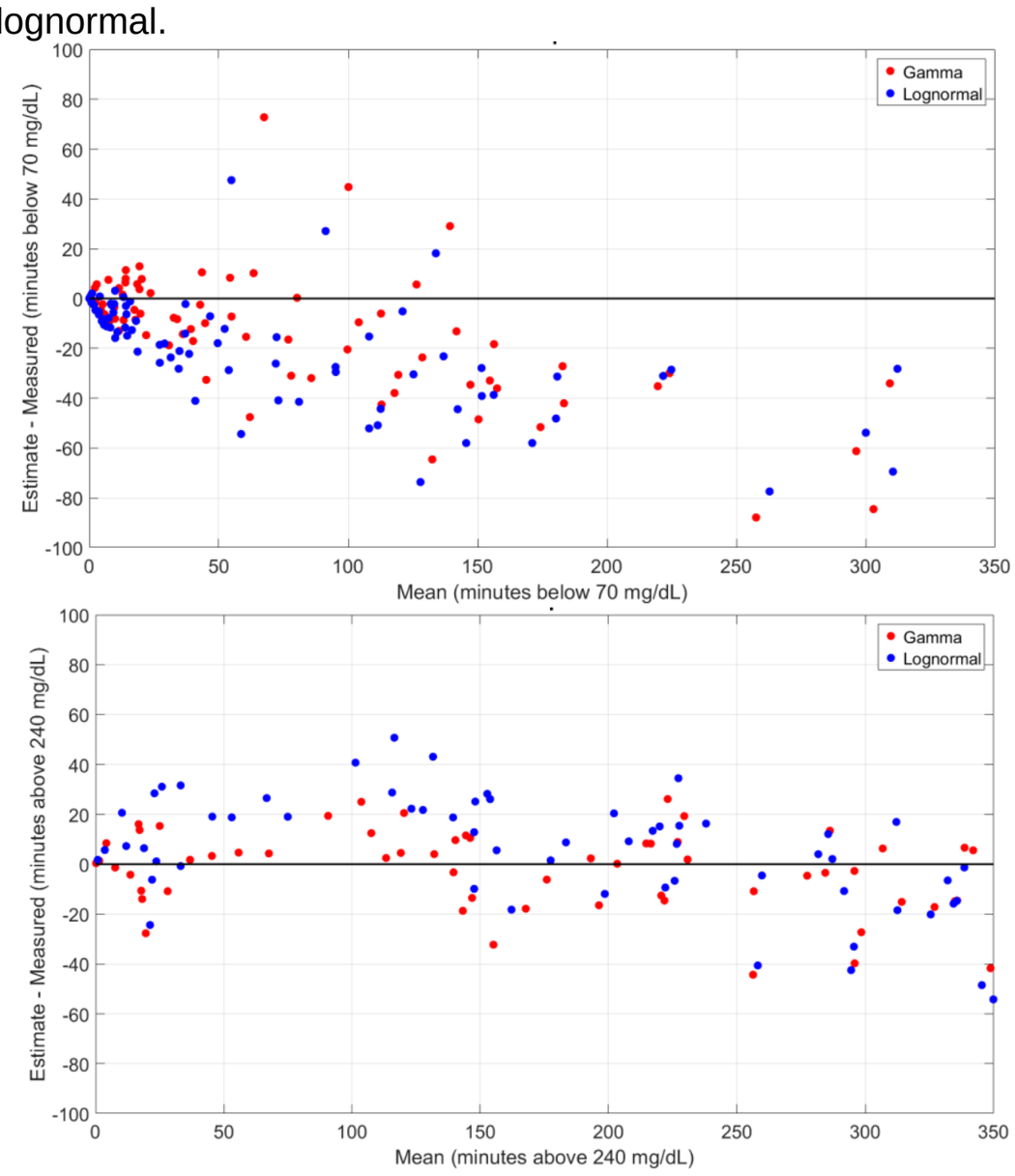

Figure 3. Bland-Altman plots showing degree of agreement between estimates and measured values of hypoglycemia (MB70) and hyperglycemia (MA240) metrics. X-axis is truncated to 350 min.

Discussion

Both distributions show large bias at high MB70 values (>150 min/day). The distributions are generally used for estimation at MB70 levels less than 120 min/day to detect transitions from low to high hypoglycemia.

Conclusions

Both distributions are a reasonable choice for estimating degrees of hypoglycemia risk; however, the gamma distribution is preferred since it has less estimate bias.

Acknowledgment

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References

[1] Dunn, T.C., Hayter, G.A., Doniger, K.J. and Wolpert, H.A., JDST, vol. 8(4), pp. 720-730, 2014.

[2] Ajjan, R., Abouglila, K., Bellary, S., Collier, A., Franke, B., Jude, E., Rayman, G., Robinson, A., Singh, B. M. Poster 993, EASD, Vienna, 2014.

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